WHAT IS CLAIMED IS:

1. A method for determining the torque applied to a fastener comprising the steps of:

applying a torque pulse to a fastener;

detecting a signal representing the time-amplitude waveform of the torque pulse;

fitting an equation that approximates the time-amplitude waveform;

processing the equation to determine the torque being applied to the fastener;

comparing the torque to a pre-set torque objective; and

applying a second torque pulse to the fastener if the torque is less than the pre-set torque objective.

2. The method of claim 1, wherein the equation includes at least one parameter selected from the group consisting of the positive amplitude; negative amplitude; absolute value of the positive amplitude minus the negative amplitude; integrated area of the positive portion of the pulse curve; integrated area of the negative portion of the pulse curve; duration of the positive portion; duration of the negative portion; area from the positive amplitude to 50% of the positive amplitude; area from the negative amplitude to 50% of the negative amplitude; duration of the positive portion measured at 50% of the positive amplitude; duration of the negative portion measured at 50% of the negative amplitude; time between the start of the positive pulse and the actual pulse peak amplitude; time between the start of the negative pulse and the actual pulse peak amplitude; and time between the peaks of the first and second torque pulses.

3. The method of claim 1, wherein the equation for the torque pulse is linear.

4. The method of claim 3, wherein the linear equation is represented by the formula:

$$\text{torque} = f(t) = \beta_0\, \varphi_0(t) + \beta_1\, \varphi_1(t) + \beta_2\, \varphi_2(t) + \beta_3\, \varphi_3(t),$$

wherein t is a time scale, and wherein $\beta_0 \ldots \beta_3$, are correlation coefficients and are determined using the method of least squares after collecting data from sample runs, and wherein $\varphi_0(t)$ represents the highest positive peak amplitude of the torque pulse, $\varphi_1(t)$ represents the negative peak amplitude of the torque pulse, $\varphi_2(t)$ represents the positive area of the torque pulse and $\varphi_3(t)$ represents the positive width of the torque pulse.

5. The method of claim 4, wherein the correlation coefficients are determined by minimizing the function, S:

$$S = \sum_{i=1}^{n} [\, y_i - \beta_0\, \varphi_0(x_i) - \beta_1\, \varphi_1(x_i) - \beta_2\, \varphi_2(x) - \beta_3\, \varphi_3(x_i)]^2$$

6. The method of claim 1, wherein the equation for the torque pulse is non-linear.

7. The method of claim 1, wherein the step of converting the signal into an equation representing the torque pulse is accomplished by selecting one

mathematical expression from a set of mathematical expressions and selecting at least two parameters that describe the torque pulse from a set of parameters.

8. The method of claim 1, wherein the signal is produced by a magnetoelastic torque transducer associated with a shaft and an induction coils proximate the shaft.

9. The method of claim 1, wherein an impact tool is used to apply the torque pulse to the fastener.

10. The method of claim 1, wherein the impact tool is a pneumatic-driven torque wrench.

11. A method for determining the torque applied to a fastener comprising the steps of:

applying a plurality of torque pulses to a fastener during a fastener tightening sequence, wherein the torque pulses have a duration and amplitude;

detecting a signal representing the time-amplitude waveform shapes of each of the torque pulses;

converting the signals into mathematical expressions representing each of the torque pulses, wherein the mathematical expressions include parameters representing at least the amplitude and duration of the torque pulses;

processing the mathematical expressions to obtain the torque applied to the fastener during the torque pulses; and

terminating the fastener tightening sequence if the torque is approximately

equal to a pre-set torque objective.

12. The method of claim 11, wherein the mathematical expressions also include at least one additional parameter selected from the group consisting of the maximum positive amplitude; maximum negative amplitude; absolute value of the positive amplitude minus the negative amplitude, integrated area of the positive portion of the pulse curve; integrated area of the negative portion of the pulse curve; duration of the positive portion; duration of the negative portion; area from the positive amplitude to 50% of the positive amplitude; area from the negative amplitude to 50% of the negative amplitude; duration of the positive portion measured at 50% of the positive amplitude; duration of the negative portion measured at 50% of the negative amplitude; time between the start of the positive pulse and the actual pulse peak amplitude; time between the start of the negative pulse and the actual pulse peak amplitude; and time between successive positive peak amplitudes.

13. The method of claim 11, wherein the mathematical expressions for the torque pulses are linear expressions.

14. The method of claim 13, wherein the linear mathematical expressions are represented by the formula:

$$\text{torque} = f(t) = \beta_0\ \varphi_0(t) + \beta_1\ \varphi_1(t) + \beta_2\ \varphi_2(t) + \beta_3\ \varphi_3(t),$$

wherein t is a time scale, and wherein $\beta_0 \ldots\ \beta_3$, are correlation coefficients and are determined using the method of least squares after collecting data from sample runs,

and wherein $\varphi_0(t)$ represents the highest positive peak amplitude of the torque pulses, $\varphi_1(t)$ represents the negative peak amplitude of the torque pulses, $\varphi_2(t)$ represents the positive area of the torque pulses and $\varphi_3(t)$ represents the positive width of the torque pulses.

15. The method of claim 14, wherein the correlation coefficients are determined by minimizing the function, S:

$$S = \sum_{i=1}^{n} [\, y_i - \beta_0\, \varphi_0(x_i) - \beta_1\, \varphi_1(x_i) - \beta_2\, \varphi_2(x) - \beta_3\, \varphi_3(x_i)]^2$$

16. The method of claim 11, wherein the mathematical expressions for the torque pulses are non-linear.

17. The method of claim 11, wherein the step of converting the signals into mathematical expressions representing the torque pulses is accomplished by selecting one mathematical expression from a set of mathematical expressions and selecting at least two parameters that describe the torque pulses from a set of parameters.

18. The method of claim 11, wherein the signal is produced by a magnetoelastic torque transducer associated with a shaft and an induction coils proximate the shaft.

19. The method of claim 11, wherein an impact tool is used to apply the plurality of torque pulses to the fastener.

20. The method of claim 11, wherein the impact tool is a pneumatic-driven torque wrench.

21. An apparatus for producing a plurality of torque pulses during a tightening sequence of a fastener comprising:

an impact tool;

a shaft operatively connected to the impact tool;

a torque transducer coupled to the shaft;

a sensor proximate the torque transducer; and

a controller,

wherein the controller enables the impact tool, applies one or more pulses to the shaft, receives waveform signals from the sensor, monitors and conditions the signals; selects an equation that approximates the signals; processes the equation to obtain the torque on the fastener; and disables the impact tool, and wherein the equation represents the time-amplitude curve of the one or more pulses and includes parameters for the amplitude, duration and the area under the time-amplitude curve.

22. The apparatus of claim 21, wherein the impact tool is a pneumatic torque wrench.

23. The apparatus of claim 21, wherein the equation is linear.

24. The apparatus of claim 23, wherein the linear equation is represented by the formula:

$$\text{torque} = f(t) = \beta_0\, \varphi_0(t) + \beta_1\, \varphi_1(t) + \beta_2\, \varphi_2(t) + \beta_3\, \varphi_3(t),$$

wherein t is a time scale, and wherein $\beta_0 \ldots\ \beta_3$, are correlation coefficients and are determined using the method of least squares after collecting data from sample runs, and wherein $\varphi_0(t)$ represents the highest positive peak amplitude of the torque pulse, $\varphi_1(t)$ represents the negative peak amplitude of the torque pulse, $\varphi_2(t)$ represents the positive area of the torque pulse and $\varphi_3(t)$ represents the positive width of the torque pulse.

25. The apparatus of claim 24, wherein the correlation coefficients are determined by minimizing the function, S:

$$S = \sum_{i=1}^{n} [\, y_i - \beta_0\, \varphi_0(x_i) - \beta_1\, \varphi_1(x_i) - \beta_2\, \varphi_2(x) - \beta_3\, \varphi_3(x_i)]^2$$

26. The apparatus of claim 21, wherein the equation is non-linear.